

Modeling Spacesuit-Human Interaction for Injury Risk Identification

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Performing functional tasks while inside of the space suit introduces additional ergonomic challenges which can lead to musculoskeletal stresses and injuries in astronauts. Computational modeling of the suit-body interaction can be used alongside human-in-the-loop testing to understand and mitigate these risks and potentially improve the work performance. In this work, a static rigid-body model of the human body was integrated with the space suit and the process is described. This model enables prediction of the resulting joint torques and musculoskeletal loading from a simulated extravehicular activity (EVA) task. For representative EVA tasks, joint torque and body angles were used as parameters to predict the muscle strength required to achieve the task, as well as the percentage of the general and astronaut-like population that could achieve that strength demand. Population strength capability can be used as an indicator of the difficulty of a task and the level of injury risk for the given task types and crew anthropometry. The sensitivity of the model to inputs such as body joint location within the space suit and individual anthropometry will also be evaluated. Future work will use a database of 3D human body scans and the movements of the body inside the suit during different EVA tasks to identify potential soft tissue contact points. The specific locations and magnitudes of contacts between the body and suit are expected to identify risk of repetitive tissue contact stresses. Overall, this model will provide a new tool to structurally identify the injury risks of EVA tasks and evaluate alternate strategies to reduce injury risk.